Presentation to the
Lake Roosevelt Water Quality Council

The Effects of Trace Elements on Water Quality and Biological Health in the Lake Roosevelt National Recreational Area: Columbia River In Cooperation with NPS

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Washington Water Science Center
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Objectives of Project

- Assess the movement of trace elements from the sediment to the overlying water column
- Assess the bioaccumulation of trace elements to the biota
- Assess the bioavailability and toxicity of the sediment to the biota

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Process-Oriented Studies at 8 sites

- **Release of metals from sediments**
  - Analysis of ambient porewater (0 – 2 cm) from four replicate cores
  - Analysis of water overlying a 20-cm core over 4 weeks
- **Bioavailability of metals**
  - Two toxicity tests
  - One bioaccumulation study
  - Acid volatile sulfur-simultaneously extracted metals
  - Sequential selective metals

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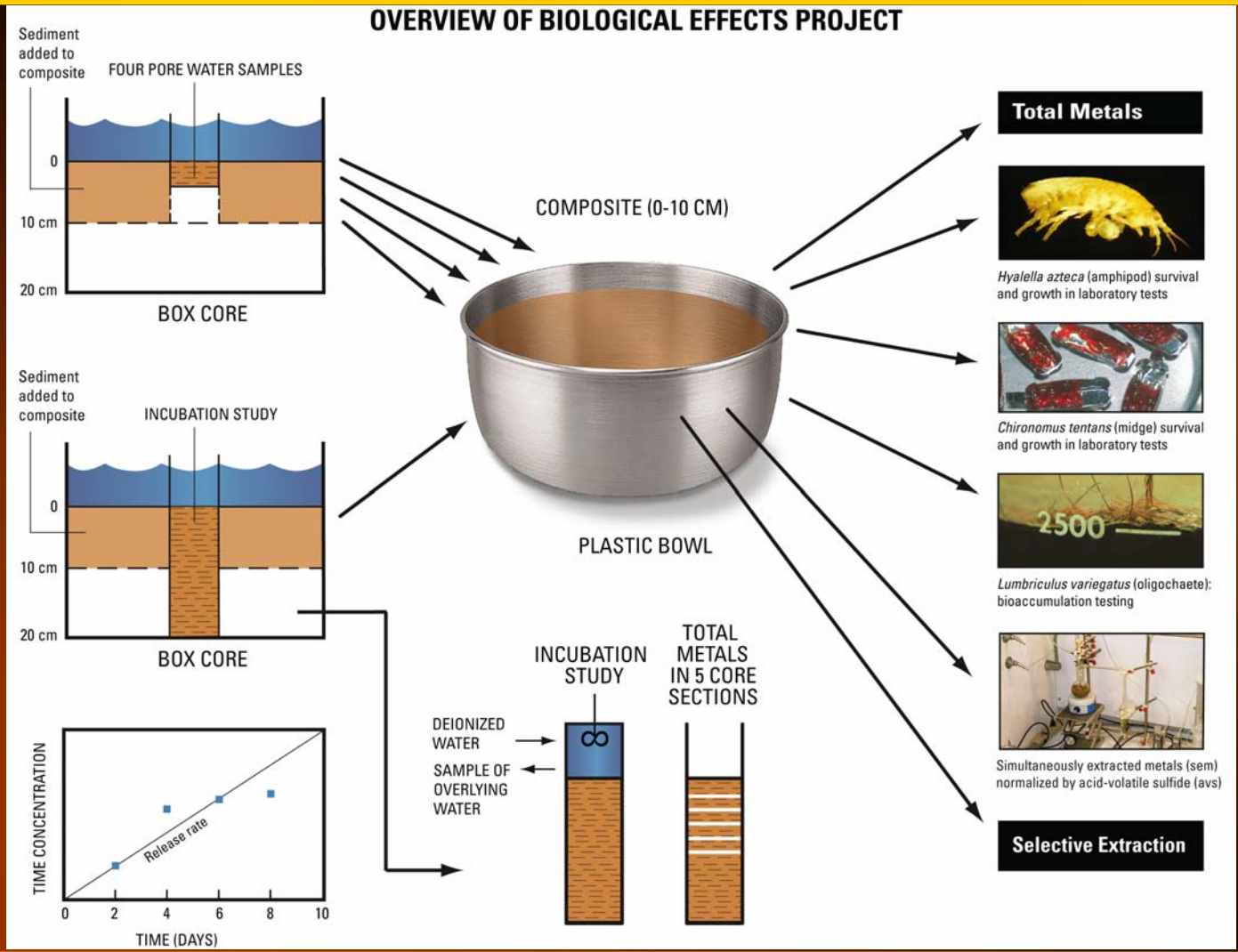
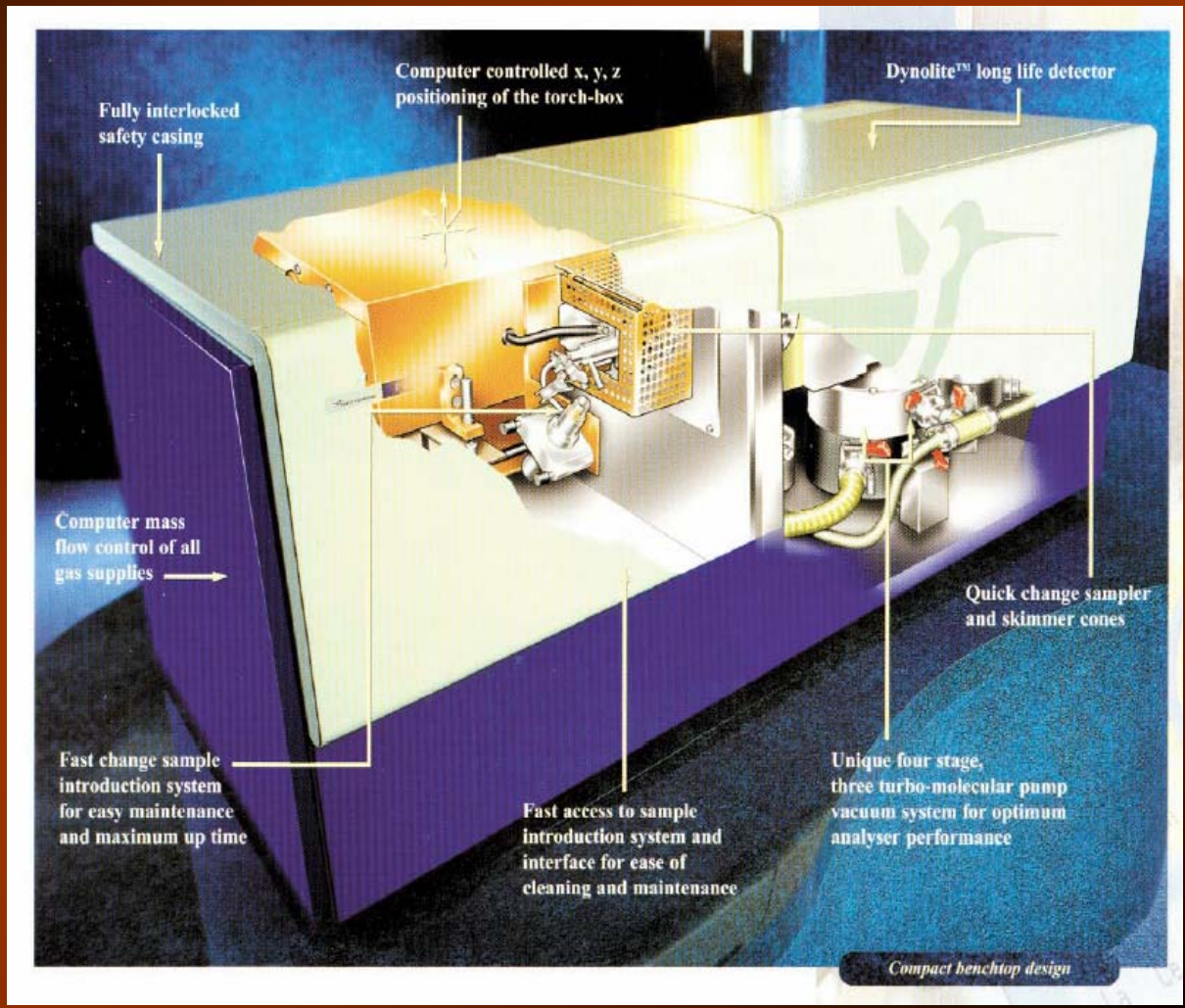
Schematic of Sample Collection and Analysis



Total Metal Concentrations

- Analysis of solution by ICP-MS after digestion with nitric and hydro-fluoric acid



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Toxicity Test No. 1

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Toxicity Test No. 2

Chironomus tentans **(midge) survival and growth in laboratory tests**

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Bioaccumulation

Bioaccumulation Study

Simultaneously Extracted Metals (SEM) Normalized by Acid-Volatile Sulfide (AVS)

- **EPA Method 376.3 –**
  - AVS measures the amount of labile sulfur
  - SEM measures the amount of metals that are released with the labile sulfur
  - Toxicity is rarely observed when the ratio of SEM:AVS is less than 1.0

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Selective Extraction: Four Sequential Solutions

#1:	Weakly Adsorbed: 0.11 M Acetic Acid
#2:	Bond to Fe and Mn oxide coatings: 0.5 M Hydroxylamine Hydrochloride
#3:	Organic and sulfide mineral phases: 30% Peroxide stabilized with 1 M ammonium acetate
#4:	Associated with lattice including slag: Nitric-hydrofluoric acid

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Quality-Assurance—Pore and Incubation Waters for 72 Samples

- Four Filtering Blanks
- Two Standard Reference Material (SRM)
- One Incubation Column Blank
- One Incubation Replicate (5 samples)

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QA—Total Metal Concentrations for 48 Sediment Solids

- Three laboratory Blanks
- Duplicates of Two SRMS (Four samples)
- Field Split (One Composite)

QA- Toxicity Tests for Each Site

- **Two test species**
  - **Midge (Chironomus tentans)**
  - **Amphipod (Hyalella azteca)**
- **Using standard and approved test**
  - **ASTM 1706-00**
  - **Strict test performance criteria**
  - **Control and reference toxicants**
- **3-4 Test Replicates per site**
- **Using established lab**
  - **Long term organism cultures and test performance history**
  - **Good Laboratory Practices (GLP) Documentation**

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QA- Bioaccumulation Test for Each Site

- **One species - Earthworm**
  (Lumbriculus variegatus) (Survives very well in freshwater sediments)
- **Using standard, peer reviewed and approved Test**
  - **ASTM E1688-97**
  - **Test has strict performance criteria**
  - **Control organism body burden measure before and after test**
  - **All test organism body burden measured after test**
- **3-4 Test Replicates per test**
- **Using established lab**
  - **Long term organism cultures and test performance history**
  - **Follow GLP practices & documentation**

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QA—AVS-SEM for 8 HCl Solutions

- Matrix Blank (AVS & SEM)
- Processing Blanks (AVS & SEM)
- One Replicate (AVS & SEM)
- Calibrated on six elements, semi-quantitative on all others (SEM)

QA—Sequential Selective Extraction for 32 Solutions in 4 Different Extracts

- Matrix Blanks (4 extracts)
- Processing Blanks (4 extracts)
- Two SRMs (2 replicates in 4 extracts)
- One Replicate (4 extracts)

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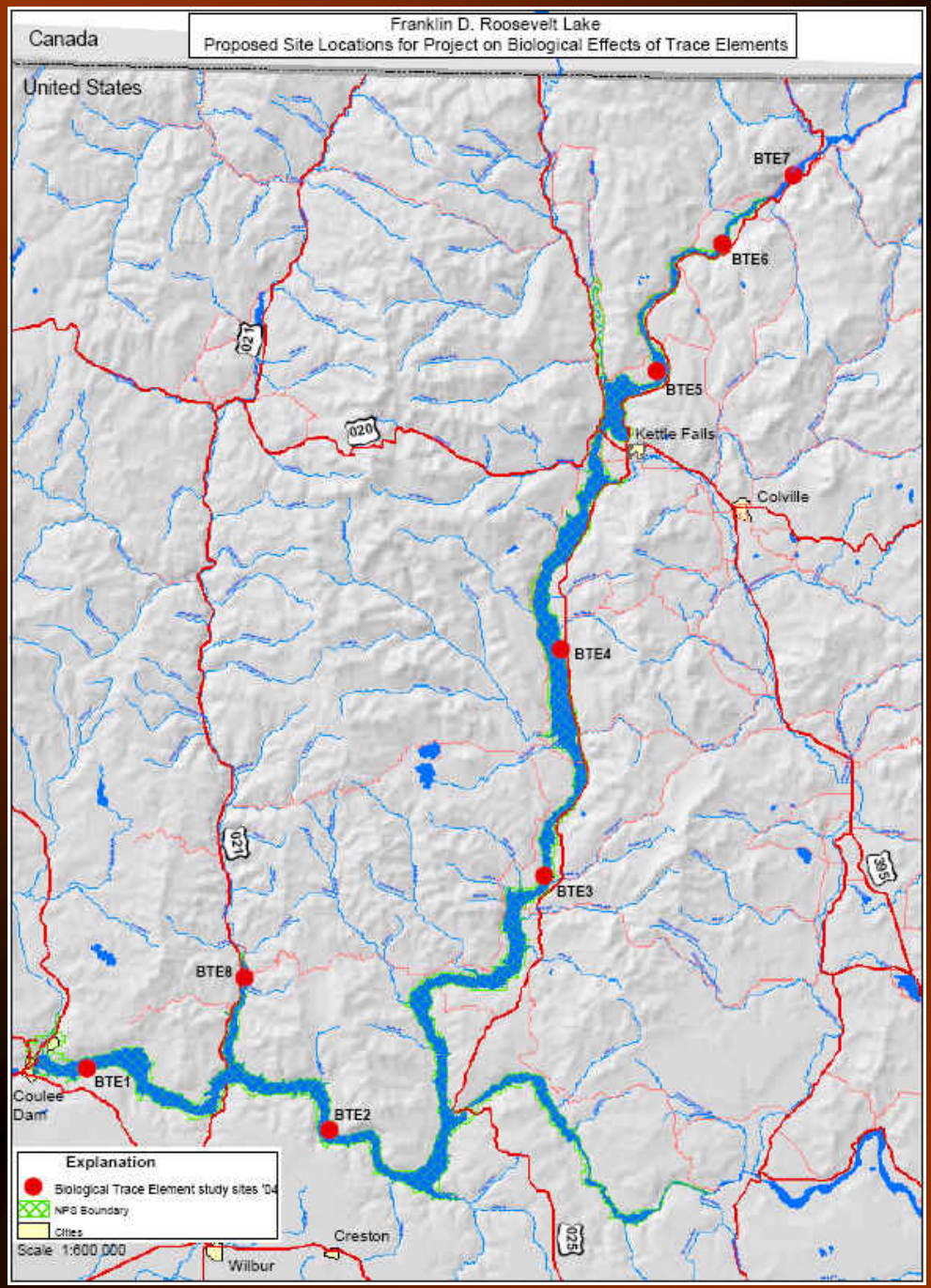
Canada
Franklin D. Roosevelt Lake
Proposed Site Locations for Project on Biological Effects of Trace Elements
United States
BTE7
BTE6
BTE5
Kettle Falls
Colville
BTE4
BTE3
BTE8
BTE1
Coulee Dam
BTE2
Creston
Wilbur
020
021
025
395
Explanation
Biological Trace Element study sites '04
NPS Boundary
Cities
Scale 1:600 000

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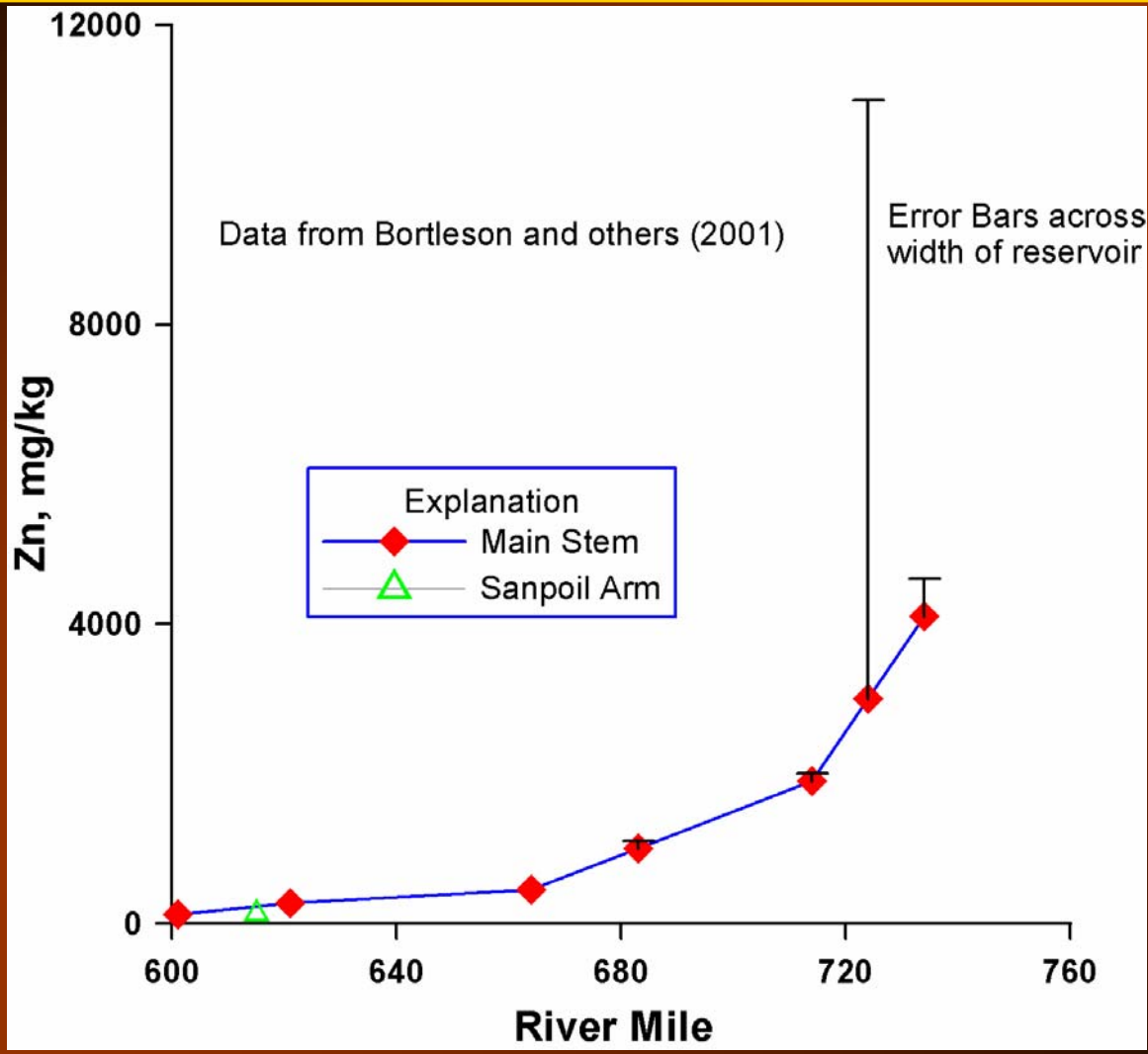
Zn Concentrations at Proposed Sites: From Previous Studies



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Water Science Center in Washington

http://wa.water.usgs.gov/

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